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NEW OBSERVATIONS OF THE OTTO STRUVE DOUBLE STARS.

By W. J. Hussey.

Early in the history of the Pulkowa Observatory a plan of work for the meridian-circle, afterwards materially modified, contemplated the exact determination of the places of all stars of the Northern Hemisphere to the seventh magnitude, inclusive. At that time there was no complete list of such stars, and to form one, giving their approximate places, was the first step in this piece of work. The formation of this preliminary catalogue was undertaken by Otto Struve. With the help of two assistants, he made the necessary observations, with the 15-inch refractor, between August 26, 1841, and December 7, 1842. In this short interval he examined with the finder of the large telescope every portion of the sky north of the celestial equator, and selected the stars (about 17,000 in number) to be included in the catalogue. Each one selected was brought to the center of the field of view of the large telescope, and its approximate position was obtained by noting the time and the readings of the hour and declination circles; at the same time it was carefully examined, to see whether it was double. This examination resulted in a list of 514 objects known, or thought to be, double or multiple, and new to science. In this list, the distances between the components were all to be less than 32″, and the magnitude of the principal star, or, in the case of close doubles, the combined magnitudes of the two, did not descend below 7.8. As companions, all objects at distances less than 16″, and bright enough to be readily measurable with the 15-inch telescope, were admitted; while for distances between 16″ and 32″ the limiting inferior magnitude of the companion adopted was 8.9.

This list of double stars, discovered at Pulkowa, was first published in 1843. Between this time and 1850, sixteen additional pairs were discovered, and were included in the second edition, published in 1850, under the title "Catalogue revu et corrigé des étoiles doubles, decouvertes à Poulkowa." Subsequently other discoveries were made, increasing the list to a total of 547 objects, which are now known as the Otto Struve double stars, or as the double stars of the Pulkowa catalogue. They are denoted by the symbol OΣ.

Many of the 17,000 stars of the preliminary catalogue were examined under poor atmospheric conditions. On this account a large number of important pairs were overlooked, and on the other hand a considerable number of stars were admitted to the list of 514 which were of a very doubtful character. A careful examination of these under better atmospheric conditions led to the rejection of 106 of them, either on account of their being single or having distances surpassing the limits adopted, or having companions too faint for exact micrometric measurement with the 15-inch telescope, or because of clerical errors in the readings or records, due in part, perhaps, to the notation employed in the formation of the catalogue. These 106 stars were omitted in the second (1850) edition of the Pulkowa catalogue, and are known as the Otto Struve rejected stars.

Volume IX of the Pulkowa Publications contains the double-star observations made by OTTO STRUVE during a period of thirty-seven years, from the establishment of the Pulkowa Observatory, in 1839, to 1875. A section of this work is devoted to the 441 Otto Struve stars not rejected, and contains about 2,080 observations of them. Nearly all these stars were first observed in the three or four years immediately following 1843. After the beginning of 1852 only about half of the stars were observed, after 1860 less than a third, and after 1870 less than one-fifth.

A second series of measures of equal importance was made by Baron DEMBOWSKI between 1865 and 1878. In spite of the small size of his instrument (7½ inches aperture) he succeeded in obtaining excellent measures of all but the most difficult of these stars. Out of the 547 objects enumerated in the Pulkowa catalogue, he measured 432, making altogether 2,155 observations of them.

These are the only large, and in a measure complete, series of observations of these stars that have been published. Certain of them have been observed many times by different observers. These are, in general, those which have proved to be binaries, and those which have shown sufficient motion to make it desirable to have a fairly continuous series of measures of them.

Early in the present year, I began to measure the Otto Struve stars for the purpose of obtaining for this epoch determinations of the relative positions of all of them that are given in Vol. IX of the Pulkowa Publications. I subsequently added to this list such of the rejected stars as were measured by DEMBOWSKI, and some others which OTTO STRUVE rejected as single, but which other observers have since found to be double. The observing list, as thus made up, contains nearly five hundred stars, and it will require some 1,700 or 1,800 observations to obtain complete sets of measures of all of them.

The conditions have been favorable for the prosecution of this piece of work. During the past eight months I have made about 1,350 observations of 414 different stars. Three hundred and forty-one stars have been observed on three or four nights each, and are regarded as finished. It is the plan to continue the work until, in general, each star has been measured on at least three different nights.

Most of the observations are being made with the 12-inch telescope. All difficult pairs are, however, measured with the 36-inch refractor. Measurements are made only on nights when the conditions are favorable for securing good results.

The following notes relate to some of the stars that I have found of interest:

The observations of OΣ 283, by OTTO STRUVE and DEMBOWSKI, give rather discordant distances. I attempted to measure it with the 12-inch telescope, but found it difficult to obtain satisfactory measures of distance with that instrument. On examining it with the 36-inch refractor, I found the faint star a close double; distance, 1″.27; magnitudes, 11½ and 12; and the line joining them making an angle of about 10° with that which connects the principal star with the brighter of the faint components. With this configuration, it is probable that the presence of the fainter companion, by reason of its not being clearly seen, has an influence on the distance measures made with small telescopes.

Some months ago, I found OΣ 341 single (see these *Publications*, Vol. X, p. 121,) whereas the observations from 1845 to 1886 had seemed to indicate that the two components were relatively fixed at a distance of about 0″.4 or 0″.5. A recent observation, 1898, 707, shows an elongation 0″.09, and a change of quadrant, 254°.3. The smaller star has already passed periastron, and an increase of distance may now be expected.

While observing OΣ 351, I discovered the south component to be a close double, of which I have made the following measures:—

1898.572	309°.9	0″.33
592	307 .6	0 .36
595	312 .9	0 .32
707	309 .6	0 .36
1898.62	310°.0	0″.34

The north star A is decidedly brighter than B, though less bright than B and C combined. These considerations reverse the quadrant of the OΣ pair as given by previous measures. The Otto Struve pair has a distance of about 0″.6, and its components have shown no certain motion. In a private letter, Professor Burnham states that he can recall no other instance of three stars so close together. I have, however, more recently found another case. It is that of OΣ 476.

The north component of OΣ 476 is a very close double. My measures are as follows:—

1898.630	227°.7	0″.15
690	229 .5	0 .17
707	224 .4	0 .13
1898.68	227°.2	0″.15

In this case the Otto Struve pair has a distance of 0″.54, and has shown no motion.

I have looked very carefully for OΣ 546 on several occasions with both the 12- and 36-inch telescopes without finding it. Dembowski had a similar experience. In the Pulkowa catalogue of 5,634 stars, Romberg gives number 4093 as OΣ 546. I have examined this star, and do not find it double. Otto Struve measured OΣ 546 but once, and speaks of its being near Σ 2396. The measure he gives, including position angle, distance, magnitudes of components, and position in the sky, all agree so closely with those of OΣ 362 as to make it highly probable that it is identical with the latter.

Lick Observatory, September 18, 1898.